University of Texas Bulletin

No. 2242: November 8, 1922

The Texas Mathematics Teachers' Bulletin

Volume VIII, No. 1

PUBLISHED BY
THE UNIVERSITY OF TEXAS
AUSTIN

Publications of the University of Texas

The University publishes bulletins four times a month, so numbered that the first two digits of the number show the year of issue, the last two the position in the yearly series. (For example, No. 2201 is the first bulletin of the year 1922.) These comprise the official publications of the University, publications on humanistic and scientific subjects, bulletins prepared by the Bureau of Extension, by the Bureau of Economic Geology and Technology, and other bulletins of general educational interest. With the exception of special numbers, any bulletin will be sent to a citizen of Texas free on request. All communications about University publications should be addressed to University Publications, University of Texas, Austin.

B64-1122-2200

University of Texas Bulletin

No. 2242: November 8, 1922

The Texas Mathematics Teachers' Bulletin

Volume VIII, No. 1

PUBLISHED BY THE UNIVERSITY FOUR TIMES A MONTH AND ENTERED AS SECOND-CLASS MATTER AT THE POSTOFFICE AT AUSTIN, TEXAS, UNDER THE ACT OF AUGUST 24, 1912

The benefits of education and of useful knowledge, generally diffused through a community, are essential to the preservation of a free government.

Sam Houston.

Cultivated mind is the guardian genius of democracy. . . It is the only dictator that freemen acknowledge and the only security that freemen desire.

Mirabeau B. Lamar.

University of Texas Bulletin

No. 2242: November 8, 1922

The Texas Mathematics Teachers' Bulletin

Volume VIII, No. 1

Edited by

MARY E. DECHERD

Instructor in Pure Mathematics,

and

JESSIE M. JACOBS

Instructor in Pure Mathematics

This Bulletin is open to the teachers of mathematics in Texas for the expression of their views. The editors assume no responsibility for statements of facts or opinions in articles not written by them.

PUBLISHED BY THE UNIVERSITY FOUR TIMES A MONTH AND ENTERED AS SECOND-CLASS MATTER AT THE POSTOFFICE AT AUSTIN, TEXAS, UNDER THE ACT OF AUGUST 24, 1912

CONTENTS

MATHEMATICS FACULTY OF THE UNIVERSITY OF TEXAS

P. M. Batchelder
H. Y. Benedict
A. A. Bennett
J. E. Burnam
J. W. Calhoun
C. M. Cleveland
A. E. Cooper
Mary Decherd
E. L. Dodd
H. J. Ettlinger
Phillis E. Henry
Helma L. Holmes
Goldie P. Horton
Jessie M. Jacobs
Renke G. Lubben
J. N. Michie
R. L. Moore
M. B. Porter
C. D. Rice

FOREWORD

It is with reluctance that your new editors call attention to the fact that the hand that directs the fortunes of the Bulletin is no longer masculine. We should prefer to leave an unsuspecting public to fancy there had been no change, but honesty prevents us from resorting to such a policy. Much appreciation of the Bulletin has been expressed by the teachers of Texas. We hope to keep the magazine up to its former standard. We wish to express first of all our gratitude to those who are this time our contributors. We would especially commend the selections of subjects treated in this issue, and would ask that some who read this foreword would gladden our hearts by themselves writing articles on these or other interesting subjects. Perhaps it is not known that this Bulletin may be received by any teacher upon request.

THE UNIVERSITY OF TEXAS RESEARCH LECTURESHIP

The University of Texas has recently established what is called *The University of Texas Research Lectureship,* with the object of encouraging research among the members of the faculty of the University and of impressing upon the minds of the students the importance of research. The lectureship is to rotate from year to year among various groups of departments in the College of Arts and Sciences. The lecturer is chosen each year by the Graduate Council of the University after a most careful investigation of the qualifications of the members of the faculties of the departments in the group in which the award is made. The holder of the lectureship is to deliver in March of the year of award not less than three and not more than five lectures in a chosen field of investigation. These lectures and other research studies of the lecturer are to be published by the University and be given appropriate publicity and distribution.

For the year 1922-1923, this research lectureship fell to the Science Group, and was awarded to Professor Milton Brockett Porter, Professor of Pure Mathematics. Professor Porter is an alumnus of the University of Texas, having graduated in 1892. He took his Doctorate at Harvard University in 1897. He has been Professor of Pure Mathematics at the University of Texas since 1902. From time to time he has published in the leading mathematical periodicals results of research in the field of Mathematical Analysis, and in this field he stands preëminent among mathematicians in this country and abroad. The University has showed most excellent judgment in honoring Professor Porter with its first research lectureship, and in so doing, it has honored itself.

GOLDIE P. HORTON.

University of Texas, October 31, 1922.

THE TRISECTION OF AN ANGLE

There are certain angles that can be trisected by Euclidean plane geometry.

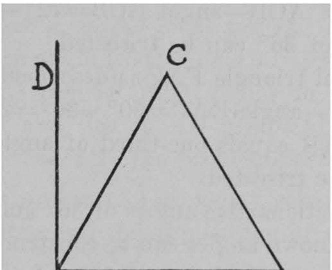


Fig 1

(1) A right angle.

From the vertex A of the right angle DAB measure on one of its sides a segment AB and on this segment describe an equilateral triangle ABC, then the angle CAD is one-third of the right angle DAB.

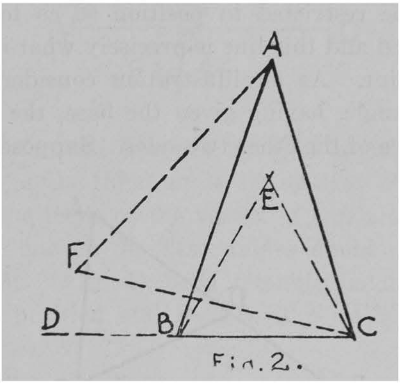


Fig. 2.

(2) An angle of 108° can readily be constructed and trisected. The tenth proposition of the Fourth Book of Euclid, viz.: "Construct an isosceles triangle having each of the base angles double the remaining angle" does this. In fact, the problem occurs in our common school texts on geometry in the inscription of a regular decagon in a circle.

Assuming therefore that ABC (Fig. 2) is an isosceles triangle such that angle ABC equals angle BCA equals twice angle BAC produce CB, then angle ABD equals angles BCA and BAC and since angle BCA is twice angle BAC hence ABD equals three times angle BAC. Since BAC is 36°, and ABC 72° angle ABD is 108°. If an equilateral triangle BEC is described on BC the angle ECA=angle ACB—angle ECB=72°—60°=12°. Consequently an angle of 36° can be trisected.

If an equilaterial triangle FAC is described on AC then angle FAB=angle FAC—angle BAC=60°—36°=24°.

Hence angle FAB equals one-third of angle ABC; that is an angle of 72° can be trisected.

Our two constructions give angles of 36° and 30° and since the difference of two known angles can be constructed hence an angle of 6° can be constructed and one of 18° trisected.

When certain necessary and sufficient conditions are given, the solutions of problems in geometry depend upon the determination of the position of points. Now if one of the conditions for determining a point in a plane geometry problem is omitted and we are asked to find the point there will result a problem having an infinite number of solutions. The required points will, however, be restricted in position so as to lie on a line straight or curved and this line is precisely what is meant by the *locus* of the point. As an illustration consider the problem: Construct a triangle, having given the base, the opposite angle and the difference of the other two sides. Suppose ABC (Fig. 3)

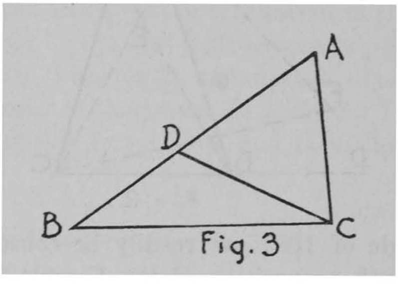


Fig. 3

is the triangle required, and make AD=AC then BD is the difference of the two sides. Also angle ADC+angle ACD=180°—A and since angle ADC=angle ACD therefore twice angle ADC =180°—A and angle ADC=90°—½ A hence BDC=180°—angle ADC

$$=180°—(90—½A)=90°+½A$$

In the triangle BDC we know BC, BD and angle BDC equals $90°+\frac{1}{2}A$. Taking the first and last of these three conditions we have a locus for the point D, namely an arc of a circle at which BC subtends a known angle. As BD is known and B is a fixed point we have a second locus for D. Hence D is determined uniquely since angle BDC equals $90°+\frac{1}{2}A$. As the point A is equally distant from D and C it lies on the perpendicular bisector of DC. It also lies on BD produced. Therefore A is determined and consequently the problem is solved.

The solution of a problem in geometry consists in an analysis of the given conditions and the application of a few known locus theorems.

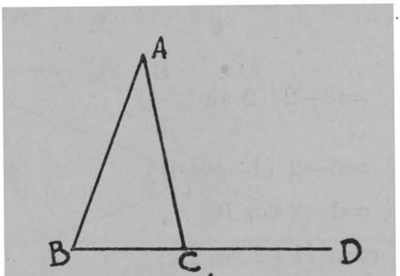


Fig 4

Reverting now to the isosceles triangle having each angle at the base double of the third angle, let us drop one of the conditions and find the locus of the vertex of a triangle which has a given base and one of the base angles double of the vertical angle. Let ABC (Fig. 4) be a triangle having BC fixed in magnitude and position and B=2A, it is required to find the locus of the vertex A.

Denote BA by r, BC by a:

Law of Sines: $$\frac{r}{a}=\frac{\sin BCA}{\sin A}$$

$$=\frac{\sin ACD}{\sin A}=\frac{\sin (B+A)}{\sin A}$$

$$= \frac{\sin \frac{3B}{2}}{\sin \frac{B}{2}}, \text{ since } A = \tfrac{1}{2}B$$

$$= \frac{3 \sin B/2 - 4 \sin^3 \frac{B}{2}}{\sin 3/2}$$

$$= 3 - 4 \sin^2 \frac{B}{2}$$

$$= 3 - 2 \left(2 \sin^2 \frac{B}{2}\right)$$

$$= 3 - 2 (1 - \cos B)$$

$$= 1 + 2 \cos B$$

hence $\quad r = a\,(1 + 2 \cos B).$

This is the equation of the locus of A in polar co-ordinates, B being the pole and BD being the polar axis.

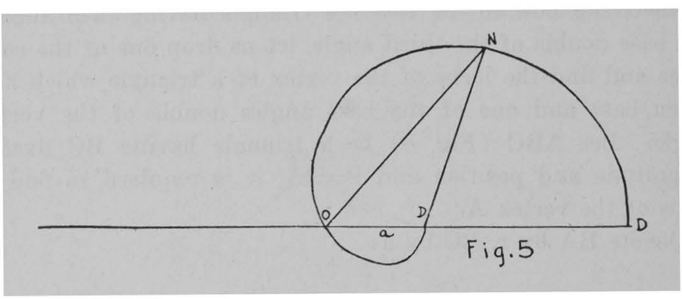


Fig. 5

Plotting the locus for values of B from 0° to 180° we have the curve DNOP (Fig. 5). For values of B from 180° to 360° the resulting curve will be symmetrical to DNOP with respect to OD. To trisect an angle make at the point P in the axis OD an angle say NPD equal the given angle. Join N with the pole O then the angle ONP equals one-third of the given angle.

The equation of the curve in rectangular co-ordinates reduces to

$$x^2+y^2-2ax=a\sqrt{x^2+y^2}.$$

This, of course, is a higher plane curve. In plane elementary geometry the only curves used are the straight line and circle so our problem is outside the domain of the geometry of the point, straight line and circle.

PRACTICAL SOLUTION

The following is an easy practical solution of the problem of trisecting an angle.

Let ABC (Fig. 6) be the angle to be trisected. With B as

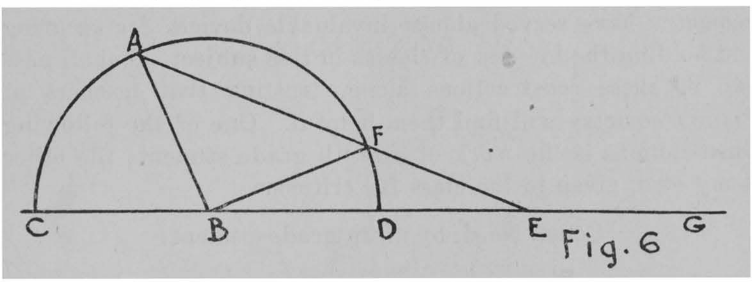


Fig. 6

center and any radius BC describe a semicircle CAD. Place a set square along CDG and mark from the end of a ruler a distance equal the radius BC. Slide the ruler along the set square keeping the edge always on the point A. When the mark on the ruler coincides with a point on the circle draw AFE the trace of the ruler in this position, then angle FBD equals one-third of angle ABC

$$\begin{aligned} <ABC &= <A + <E \\ &= <AFB + <E \\ &= (<E + <FBD) + <E \\ &= 3<FBD. \end{aligned}$$

This solution is said to be due to Archimedes but has been rediscovered several times and published accordingly up to June, 1922.

P. H. UNDERWOOD,

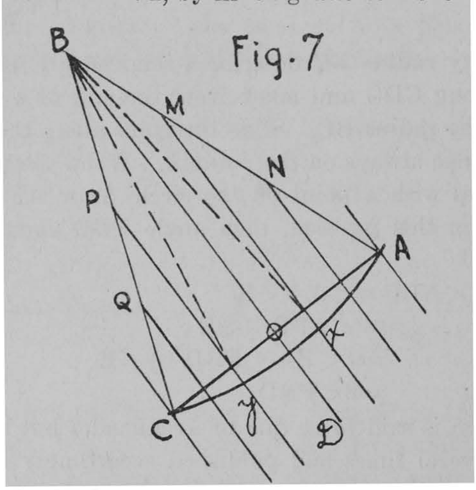
Ball High School, Galveston.

IS GEOMETRY A DRAG?

A few years ago when there was some discussion through certain educational journals of that age-worn proposition of the trisection of any angle I was teaching a class of representative ninth grade students in Plane Geometry. I remember that there was an unusual amount of interest in the proposition manifested by members of the class. They seemed to consider it a personal challenge and even questioned the finality of the verdict that it cannot be done in Plane Geometry. They set themselves to work on constructions and interesting, indeed, were their efforts. In a few cases nothing less than a long process of reasoning could convince them of an existing fallacy.

This proposition together with certain other reactions in geometry have served almost invaluable devices for securing and holding the interest of classes in this subject. I shall pass two of these constructions along, trusting that teachers of Plane Geometry will find them helpful. One of the following constructions is the work of a ninth grade student; the other is my own, given to the class for criticism.

Const. No. 1, by ninth grade student



Given Angle ABC.
Req. to trisect Angle ABC.
Const. Take AB=BC. Bisect Angle ABC by line BD.

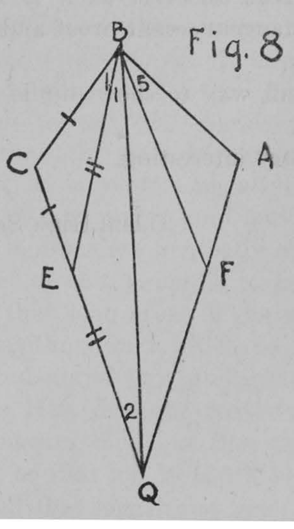
Trisect AB by points M and N. Trisect BC by points P and Q. With B as center and AB as radius describe arc AC and draw lines through M, N, A, P, Q, and C parallel to BD. Draw BX and BY. Now BX and BY trisect Angle ABC.

Proof: Draw AC. AC⊥BD (AB=BC and BD bisects <ABC).

Now these parallels intercept equal segments on AO and OC. OC=AO, therefore the parallels are the same distance apart, hence they cut equal arcs on the circle. (Parallels intercept equal arcs on a circle.) The angles ABX, XBY, and YBC are each measured by the sum of these equal arcs and are therefore equal.

Where is the fallacy? Can your class find it?

Const. No. 2.



Given <ABC.

Req. To trisect it.

Const. Take AB=**B**C.

Bisect <ABC by line BQ.

Locate points E and Q such that CEQ is a st. line, BC and CE, and BE=EQ. (By means of compass like instrument made by instructor.)

Join points A and Q. Take AF=AB. Draw BF. Now BF and BE trisect ABC.

Proof: $\angle 1=\angle 2$ and $\angle 3=\angle 4$ (Base $\angle$s is isosceles $\triangle$s.)
$\angle 3=\angle 1+\angle 2=2\angle 1$ (Ext. $\angle$ of $\triangle$=sum of opp. int. $\angle$s.)
But $\angle 4=\angle 3$,
$\therefore \angle 4=2\angle 1$
$\therefore \angle 4=\frac{2}{3}\ \angle QBC$ or half of $\angle ABC$
$\therefore \angle 4=\frac{1}{3}\ \angle ABC$
Similarly $\angle 5=\angle\frac{1}{3}\ \angle ABC$.
$\therefore$ BF and BE trisect angle ABC.

Another method that is sure to bring results is the practice of proving theorems by use of figures different from those given in the texts. For instance, ask your class to prove that the sum of the angles of a triangle equal a straight angle by drawing a line through the vertex parallel to the base. Or let them prove the Pythagorean theorem as it is given in the book. Then give them the tangent-secant proof and ask for comparison of the two methods.

This is an excellent way to show pupils that geometry is a science, not a book.

Let's make geometry interesting.

R. A. Eads,
Odem High School, Odem, Texas.

LEARN TO "ROLL YOUR OWN" LOGS

Wherever algebra of any degree of advancement is taught or a course is given in trigonometry, student and teacher come in contact with logarithms. (Usually abbreviated to "logs.") It is not the purpose of this paper to give any discussion of the use or the pedagogy of logarithms. The method of using them is so simple and so mechanical and so well explained in text books and usually gives the student so little trouble that it seems not worth while to discuss it.

It may not be amiss, however, to remark that the common "rule of thumb" method of finding characteristics does not seem generally to have its origin discussed and understood with sufficient clearness. Any student, almost, who has ever collided with the subject at all will say without hesitation that the characteristic of the logarithm of 358 is 2. Asked how he knows it is 2 he says, "because the number has three figures." Asked why a three-figure number should have 2 for the characteristic, he usually becomes incoherent. There is, of course, even less clearness as to why the characteristic of the logarithm of .56 should be —1. It is rare that a student knows that the logarithm of .56 is really a negative number and why it is so. This is so easy to understand and to explain that it seems a pity that it is not more generally appreciated.

But the real object of this paper is to help the teacher to answer the question that soon arose in the mind of the writer on encountering logarithms, and which he suspects arises in the minds of most students of fair intelligence and a modicum of curiosity, to wit: How does the writer of a book or anybody else, for that matter, find out that the logarithm of 7, for instance, is .8451 or that log 13 is 1.1139?

The writer was told that logarithms were calculated by advanced methods which the teacher could not at that time explain to him. (He feels sure that this statement was literally true.)

It is true that anyone under the necessity of computing a table of logarithms correct to any considerable number of decimal places would use methods not intelligible to high school students or college freshmen. But it is not at all necessary to use such methods to calculate the logarithms of numbers good for a few places of decimals and to show students how logarithms may actually be calculated by very elementary methods. The student can use the methods to calculate logarithms the correctness of which he may verify by comparing with the tables.

The method has the disadvantage of being, in most cases, rather long and somewhat laborious but it is simple and it works.

In beginning the subject it is necessary to have a complete understanding of what we are going to mean by the logarithm of a number and what assumptions concerning them we are going to make. In this discussion all logarithms will be supposed to be calculated to the base 10. This gives no added simplicity, it is only assumed for the sake of definitness. What will be said could be said about logarithms to any other base just as well.

Definition of a Logarithm:

Let $10^x = a$, then x is the logarithm of a.

(N. B.: The logarithm of a is written log a.)

Assumption: There is a real value of x that satisfies the equation $10^x = a$ where a is any real, positive number.

It should be noted that the definition given is equivalent to writing the defining equation $10^{\log a} = a$. This exhibits at once the exponential nature of logarithms.

Since then, logarithms are exponents they obey the laws of exponents:

e. g. $10^{\log 47} = 47$

$10^{\log 39} = 39$

Multiplying we have:

$\therefore 10^{\log 47 + \log 39} = (47)\ (39)$

i. e. The logarithm of the product of two numbers is the sum of their logarithms. All the other laws of logarithms can be inferred in the same way by means of the laws of exponents. It goes without saying that logarithms should be taught in connection with the theory of exponents.

Of course, the attention of the student should be called to the fact that in calculating a table of logarithms only the logarithms of the prime numbers would have to be found from first principles. i. e. that given the logarithms of 2, 3, 5, 7 we would have at once the logarithms of all such numbers as 4, 6, 8, 9, 10, 12, 14, 15, 16, 18, 20, 21 and many others.

Let us see, then, how we could begin to try to calculate log 2. Since we know at once the logarithms of all integral powers of 10, we may write the following inequalities:

$10 < 2^5 < 10^2$ because $32 (=2^5)$ lies between 10 and 100. Taking now the fifth root of every number of this inequality we have $10^{1/5} < 2 < 10^{2/5}$. $\therefore$ 1/5 is too small for the log 2 and 2/5 is too large. This tells us that log 2 is between .2 and .4. But this does not tell us whether the first figure is 2 or 3. Since so far as we have yet found the log of 2 might equal .28 or .35, say, since both these are between .2 and .4. Let us then use a higher power of 2. e. g. $10^2 < 2^9 < 10^3$. Taking ninth root $10^{2/9} < 2 < 10^{3/9}$. $\therefore$ Log 2 is between 2/9 and 3/9. 2/9=.222---. 3/9=.333---.

Now, whereas, we found first that log 2 was between .2 and .4, two numbers separated by a gap of .2 we now know log 2 is between 2/9 and 3/9, two numbers separated by only 1/9 or .111—but we still do not know whether the first figure of log 2 is 2 or 3.

Again $2^{10}=1024$. $\therefore 10^3 < 2^{10} < 10^4$.

$\therefore 10^{3/10} < 2 < 10^{4/10}$. $\therefore$ Log 2 is between .3 and .4, but above we found that log 2 was less than .33. We now know that log 2 is between .3 and .33, and this fixes the first figure as 3.

Proceeding: $2^{13}=8192$.

$\therefore 10^3 < 2^{13} < 10^4$.

$\therefore 10^{3/13} < 2 < 10^{4/13}$. $\therefore$ Log 2 is between 3/13 and 4/13 or between .23 and 307. But we found above that log 2 is larger than .3. It is therefore between .3 and .307.

$\therefore$ The first two figures of log 2=.30.

In a similar manner we can calculate the logarithm of 3.

3^{20}=3, 386, 783, 861.

$\therefore 10^9 < 3^{20} < 10^{10}$.

$\therefore 10^{9/20} < 3 < 10^{10/20}$.

$\therefore$ Log 3 lies between 9/20 and 10/20, that is between .45 and .5.

We now see that the first figure of log 3 is 4 and the second is 5, 6, 7, 8, or 9. Taking a still higher power of 3 we could find that the second figure is 7 and so on as long as our time and our patience lasted.

It is worth noticing that in finding 3^{20} we are not interested in getting an exact result as we need only to know the number of digits in the result. Since $3^4 = 81$, $3^{20} = (81)^5$ and in finding $(81)^5$ we can ignore the 1 and find $(80)^5$ as it will have the same number of digits as $(81)^5$.

It seems to the writer that these operations can be explained to students in the senior class of the high schools and experience has shown that they can be understood and carried out by college freshmen. This serves to destroy the mystery about logarithms and whatever tends to assist the mind to substitute its own findings for an *ipse dixit* is surely worth while.

J. W. CALHOUN.

A SUGGESTION

We, of the mathematics department, are apt to blame the English teachers for the poor language used by our students. The fitting retort might be that we render their teaching ineffective by not insisting on good English in all our work. Errors in expression of mathematical ideas and in spelling and and pronunciation of mathematical terms are so common in our pupils' work as to make us suspect that they are tolerated, if not actually taught, by some teachers. Such mistakes, if not corrected, must needs bring discredit to our schools. A five minutes' lesson once a month together with daily correction of errors might raise the standard to what we should desire and expect.

A list of mistakes commonly made follows. In expression: Equals to or ta, respectfully for respectively, planes intersect *at* a line.

In spelling: Squre, coinside, isoscles, perpindicular, equasion, plain for plane, paralel, suplement, compliment for complement, corrospinding, intersept, locust, tangeant, cord for chord, axium, consequence for consequents, quanity, simullar or similiar, pologon, extreams, segement, therom.

In pronunciation: Inversion, equation (mispronounced by many teachers) parallel, congruent, alternate.

If we could anticipate such errors, and by drill in correct forms fix them in the memory before the students have a chance to learn incorrect forms, we might save time and annoyance.

MISS ANNA H. JONES,
Main Avenue High School, San Antonio, Texas.

The editors would call attention also to the use of *graft* for *graph*, of *onto* for *multiplied by*. Another high school teacher remarks on the use of the word *cancel* in two senses. Should not the term be restricted to the process of removing a common factor from numerator and denominator?

TEACHING THE GRAPH

Plotting and graphing are of such importance in the field of mathematics, that it will be well to think along that line a little here. Plotting plays an important part in bringing truths and the meanings of theorems and problems before the eyes of the pupils that a thorough knowledge of the subject should be obtained, before the student has advanced very far in mathematics. Dry, uninteresting algebra can be made more vivid and meaningful by the use of the graph; answers to problems, roots of equations, are made more intelligible by a proper presentation of the graph.

Many questions arise with regard to the graph among which are: Is it best to allow the student to receive instruction in this phase of mathematics in the college or university? Or is it best to wait until the close of the second year in high school algebra, and then give about one week to the subject? Or is it best to begin teaching the graph in the eighth grade and add to this as the pupil advances through the two years of algebra? Some teachers do not teach plotting in the high school. They believe that this method should be taught in the freshman year in the colleges and universities. Others give a little time to the graph at the close of the second year in algebra, at a time when the pupil can not very well use it in a better understanding of algebra. And again, there are some teachers who teach the graph throughout the two years of high school work.

To do the most effective work in high school algebra, plotting should by all means be introduced in the eighth grade, after the student has had some work in simple equations.

Knowing that the line or curve is the geometric representation of an equation in the book is more illuminating to the eighth grade boy or girl than one might think.

A class should never leave simultaneous equations without knowing how to solve them by the graphic method. Knowing how to check the solutions of simultaneous equations both linear and quadratic by the graph bring to the student ideas that are very helpful means to a good understanding of the subject. Do not wait until the last week in the second year of algebra to introduce this important subject, but give bits of it throughout the two years, and you will see many good results and an added interest on the part of your class.

After the pupils have learned something about the quadratic equation, introduce the graph to explain what is meant by the roots of an equation. By means of the graph a teacher can represent geometrically real and imaginary roots and thus give the pupil a clearer conception of solutions of quadratics.

D. D. BATIN,
Grubbs Vocational College.

THE BROWN MATHEMATICAL PRIZES

Of interest to high school teachers of mathematics are the Brown Mathematical Entrance Prizes offered to freshmen in the fall. In case some do not know about these prizes, I quote from the catalogue. "Out of gratitude and respect to his Alma Mater, an alumnus of Brown University offers the following prizes, known as the Brown University Mathematical Prizes, to be awarded annually by the staff of the Department of Pure Mathematics on the basis of competitive examinations.

"Entrance Prizes. Three prizes are offered of fifteen, ten, and five dollars respectively, to the freshmen making the best grades on a special examination to be held during the third week of October. The examination will cover the minimum entrance requirements in mathematics, elementary algebra and plane geometry."

The following is the examination given on October 14, 1922:

Time: One hour.

1. Through a given point draw a line intersecting a given circle so that the distance from the points of intersection to a given line have a given sum.

2. Describe a circle touching two given parallel lines and passing through a given point.

3. A man travels fifty miles by the train A and then after a wait of five minutes returns by the train B, which runs five miles an hour faster than the train A. The entire journey occupies two hours twenty-six and two-third minutes. What are the rates of the two trains?

4. The circumference of the hind wheel of a wagon exceeds that of a fore wheel by 8 inches, and in traveling one mile this wheel makes 88 less revolutions than a fore wheel. Find the circumference of each wheel.

Note: In the geometrical problems no discussion of the circumstance under which the desired construction is possible or impossible or the number of solutions obtainable in the possible case is demanded. A description of the steps in the construction and a proof that the suggested construction does indeed solve the problem, are all that is wanted.

Prize Winners:

1st. Mildred Taylor, Weatherford H. S., Weatherford, Texas.
2nd. Eugenia Rountree, Paris H. S., Paris, Texas.
3rd. Sophie Lubben, Francitas H. S., Francitas, Texas.

WHAT IS THE MATTER WITH HIGH SCHOOL MATHEMATICS?

It is a fact that more students in our universities are failing in mathematics than in any other one branch. It is now time for the high school teachers to ask themselves the question, "What is the matter with our work?" The trouble lies with us: the foundations we have laid are of sand.

When I heard a bright young college student say, "I don't know any Plane Geometry, I memorized mine for that was the only way I could 'get by,' " I thought, "some teacher has not done his duty."

Begin the subject by telling the child the history of geometry —let him realize that the people of Egypt discovered and developed this wonderful science because of its use to them in replacing their boundaries after the annual overflows of the Nile. Let the child know that geometry, like all other mathematics, is to develop the power of reasoning, that no memory work is required with the probable exception of the axioms and even these should be shown to be true. Use some simple device as: Two boys each with two pieces of crayon and give each of them two more; then the class will readily see that axiom one is true. In the same way, or by correlating with algebra, explain every axiom.

I find that a great many high school students cannot read; that is, they do not get the full meaning of the words; therefore, it is necessary not only to explain definitions but also to demonstrate where possible with the figure, as in the circle, the angle, etc., and show the pupil that the figure and definition agree.

We are now ready to begin the proofs of the theorems. I find it a good idea to state all propositions with an adverb clause introduced by *if* or *when*. If the proposition is not stated this way in the text, we restate it. The pupil is taught that there are five steps in every theorem, except in the cases of a few in proportion, where no figure is needed. First, state or restate the theorem; second, draw the figure by making it agree with the English in the statement of the theorem; third, let the adverb clause always tell what is given; fourth, have the noun clause tell what is to be proved. Now only the fifth step, the proof proper, remains. Teach the pupil to recall the conditions he has had that will aid in the proof, for all of the proof depends on axioms, definitions, and previous propositions. Use the same five steps and same method of solving in originals that you do in theorems—have every step and every reason just as complete.

I find that it often helps the beginner to understand the conditions of the proposition if I make the figures of paper. Let us take the theorem. If two triangle have three sides of one equal respectively to three sides of the other, they are congruent. I cut from paper two triangles with their three sides respectively equal. I explain to the class by doing it,—that my second triangle is placed beneath the first with their bases coinciding but vertices opposite. The line that connects these two opposite vertices is a crease in the paper. I then show the class only the left half of the figure and that in an erect position so they can easily see the triangle. I then show them the right half in the same way, and finally I show them the whole figure at once; and they thoroughly understand the angles and sides we have discussed.

Of course, all this requires effort on the part of the teacher, but if we are not enthusiastic about our work, if we do not see the beauty hidden thoughts in our subjects, if we are not anxious to have our pupils enjoy this same knowledge and beauty, if we are too lazy to put forward every effort in our power, remembering to make demands of the pupils as to study and perfect order without which no teacher can be successful, we are not true teachers of mathematics, and we can expect our pupils to be failures in college.

LILLIAN E. TUTTLE,
Palestine High School.

THE STRAIGHT EDGE

What has become of the old-fashioned boy who used to object to having the teacher show him how to do originals?

* * * * *

A GOOD MANY high schools are putting the soft pedal on mathematics. Wonder if this has any relation to how MANY GOOD high schools there are.

* * * * *

Have you ever noticed how likely it is that a student who is doing well in mathematics is doing well in his other subjects? Is the converse true?

* * * * *

Did you ever see anybody try to prove a mathematical theorem by raising his voice, pounding a desk, and rumpling up his hair? No, one who is sure of his facts does not need fireworks.

* * * * *

Don't you think some training in a field where the facts are non-controversial and where cold reason holds sway may be of some use to a citizen?